

# **An Introduction to the Health Concern in the Dwelling Performance Rating System in Mainland China**

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## **Abstract**

In 2003, the outbreak of Severe Acute Respiratory Syndrome (SARS) in 24 provinces across China caused a death toll of 349. This event aroused public concerns over the health performance of residential buildings. As a result, developers began to promote their properties with eye-catching ideas of ‘green house’, ‘natural building’, etc. However, due to the relatively short history of China’s property market, the theory, design, and management of such healthy buildings has obviously lagged behind similar efforts in developed countries.

On 13<sup>th</sup> December 2004, the Ministry of Construction approved a new Standard of House Performance Appraisal (SHPA), which is part of the Dwelling Performance Rating System (DPRS). Although there is no specific official definition of “healthy building” in the DPRS, we can discern the government’s concern with respect to the health performance of residential buildings by carefully analyzing the SHPA, which is the major focus of this paper.

First, we will give a brief introduction of the DPRS. Then we will discuss all factors dealing with the health performance of buildings and demonstrate the DPRS’s concern for healthy buildings. Finally, by carrying out an international comparative study of the DPRS with LEED, GBC, and BHHI, suggestions for the DPRS’s future advancements will be made.

**Keywords** : Healthy building, Dwelling Performance Rating System, Standard of House Performance Appraisal, Building Health and Hygiene Index, Mainland China

## **1. Introduction of the DPRS in Mainland China**

## **1.1 Purpose of the Dwelling Performance Rating System**

The Dwelling Performance Rating System (DPRS) is essentially a third-party appraisal system on various aspects of the property and its built environment. The aims of setting up the DPRS are comprehensive and are listed below:

First, the DPRS is important for promoting the sustainable development of the housing industry. It was designed to meet China's new needs under a market economy, and will consequently lead the housing industry to a faster and healthier way of development.

Second, the DPRS promotes the performance of housing. By classifying the rating system into five aspects, namely suitability, safety, durability, environment, and cost-effectiveness, the DPRS set up a uniform standard for the planning, design, and construction process.

Third, the DPRS was designed to give developers a clear guidance in making their supply decisions according to various demands. This makes supply decisions more demand-oriented.

Fourth, the DPRS was also designed to protect the interest of consumers. In Mainland China, the post-sales services system for housing has not been well established. Incorporating such a third-party appraisal system into the housing market can provide assurance for the quality of housing as well as for the post-sales service.

## **1.2 Index system of the Standard of House Performance Appraisal (SHPA)**

On 13th December 2004, the Ministry of Construction approved a new Standard of House Performance Appraisal (SHPA), which is part of the Dwelling Performance Rating System in Mainland China.

The assessment framework of the SHPA is divided into five levels. The first level is a single-vision representation of the comprehensive performance of a property. The second level breaks down the objective from the first level into five sub-objectives, which are Suitability (A), Environment (B), Cost-effectiveness (C), Safety (D) and Durability (E). Figure1 shows the first three index levels of the SHPA. In all, there is 1 first-level item, 5 second-level items, 28 third-level items, 94 fourth-level items, and 266 fifth-level items. Each item in the fifth-level is assigned a weight, which is given by experts with different backgrounds. Suitability (A) and Environment (B) have the largest weight of 250 each. Cost-effectiveness (C) and Safety (D) have a weight of 200 respectively. Durability (E) has the lowest weight of 100. The total score of a property under the SHPA is simply the summation of those scores obtained from different sub-objectives.

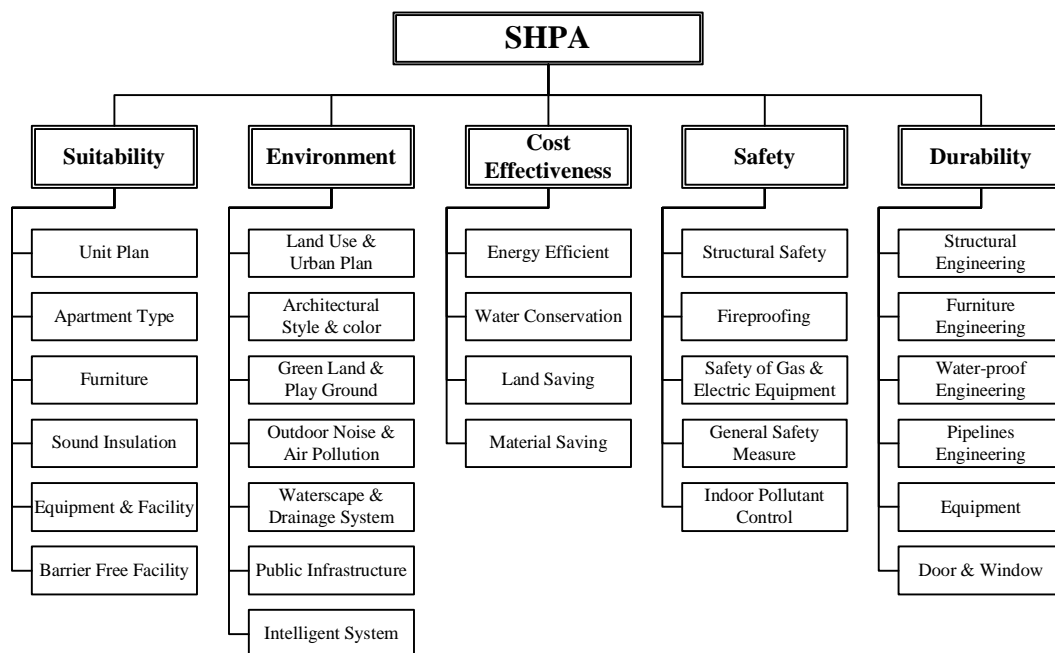


Figure1: The index system of SHPA

**Source:** *Index System of the Standard of Housing Performance Appraisal, Center for housing industrialization, China, 2004.*

### 1.3 Rating rules of the SHPA

The rating rules under the SHPA are shown in Table 1. Generally speaking, all properties are classified into two categories: A, B. “A” stands for properties with good performance with a total score of more than 600. “B” stands for properties with ordinary performance, albeit satisfies the requirements of national compulsory criteria. Within the “A” category, there are three sub-categories: A, AA, and AAA. “A” indicates that a property is economical and suitable for households with low or middle incomes. “AA” indicates that a property is more suitable for middle and high income households. Only properties achieving a score of more than 720 can get this certification. “AAA” will be awarded to a property with a score of more than 850, which shows that a property is a well-designed and very comfortable private dwelling. It is also suitable for households with high income.

Rating type	suitability	environment	cost-effectiveness	safety	durability	Total Range	
	(A)	(B)	(C)	(D)	(E)		
A	AAA	≥ 150	≥ 150	≥ 120	≥ 120	≥ 60	[850,1000]
	AA	≥ 150	≥ 150	≥ 120	≥ 120	≥ 60	[720,850)
	A	≥ 150	≥ 150	≥ 120	≥ 120	≥ 60	[600,720)
B	/	/	/	/	/	/	[ 300 ,600 )
Remark	Some items in the SHPA are marked with hollow pentacle or solid pentacle. None but projects qualify all the items marked with hollow pentacle can get ‘A’ certification. ‘AAA’ can only be awarded when projects meet the requirement of all the items marked with solid pentacle.						

Table1: Rating Rules of the DPRS

Source: *Index System of the Standard of Housing Performance Appraisal, Center for housing industrialization, China, 2004.*

### 1.4 Scope of Assessment

The DPRS is applicable to all newly built residential buildings in Mainland China. As shown in Figure 1, The SHPA generally focuses on suitability, environment, cost-effectiveness, safety, and durability. It also touches different stages of the building life-cycles, though planning and design are the primary concern.

## 2. The health concern in the DPRS

Although there is no single section deals with the health performance of the residential buildings in the DPRS, yet we can discern the government’s concern with respect to health performance by carefully analyzing the SHPA. In this part, we will talk about more on the health concern within the DPRS.

Many items in the fifth-level of the SHPA are concerned with health performance of residential buildings. They however are separately located among the five different aspects. In order to have a clear understanding of the DPRS’s concern on health performance of residential buildings, we classify all the items into seven categories in Figure 2, with their respective total scores.

Table 2 further shows all items in the SHPA which are relevant to the health concern of the residential buildings. The total score of these items add up to 163, which is about 16 percent of the total score of the SHPA.

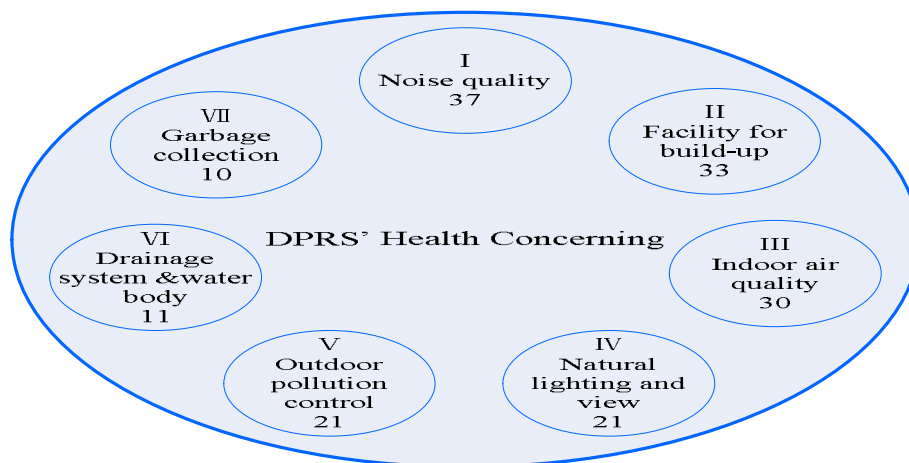


Figure2: The health concern within the DPRS

**Section A—Appraisal index of Residential Suitability**

<b>Item</b>	<b>Sub-item</b>	<b>Sub-item serial number</b>	<b>Item requirement description</b>	<b>Score</b>	<b>Sort</b>
Residential plan	Public space	A06	There is natural lighting in the main lobby and lift lobby; the ratio of window to floor is more than 10%.	1	IV
		A10	Fixing garbage collection facilities in high-floor building, and installing vent and flushing facility in the garbage room.	3	VII
Residential unit shape	Unit function and room layout	A14	There is natural lighting and ventilation in the living room, no obvious interference of sight and lighting.	5	IV,III
		A15	☆At least one habitation room can get natural lighting in an apartment. If there are more than 4 habitation rooms in the apartment, at least 2 habitation rooms can get natural lighting.	6	IV
		A16	Lighting windows of living room and master bedroom shouldn't expose to concave or lighting well.	3	IV
		A20	Kitchen can get natural lighting and ventilation, and its location is appropriate.	3	IV,III
sound insulation	Floor slab	A33	Weighted strike sound pressure of floor slab shouldn't be more than 65dB	4	I
		A34	Weighted sound reduction index of floor slab shouldn't be less than 50dB	4	I
	Wall	A35	Weighted sound reduction index of inter-unit wall shouldn't be less than 50dB	6	I
		A36	Weighted sound reduction index of exterior wall(including window) shouldn't be less than 40dB	3	I

		A37	Weighted sound reduction index of partition wall adjacent bedroom and study shouldn't be less than 40dB	3	I
	Pipe	A38	Noise of drainpipe shouldn't be more than 50dB	2	I
	Equipment	A39	Measures of vibration reduction and sound insulation should be applied in equipments.	3	I
Equipments and facilities	Water supply and drainage, gas system	A49	Water drainage equipments and instruments should have traps, and the depth of water in the trap shouldn't be less than 50mm.	2	VI
		A50	Access door of vertical pipe is convenient to clean and get through.	1	VI
		A51	Drainpipe of residential and commercial building should be separate; trap should be installed before joint.	2	VI
		A53	Vertical pipe of kitchens and toilets should be installed in the tube well, which adjoins kitchens and toilets.	1	VI
	Heating, ventilation and air condition system	A56	The air flow of residential room is well in natural condition.	1	III
		A59	There should be fresh air system, and the volume of fresh air should be more than 30 m <sup>3</sup> per hour and person.	4	III

### Section B—Appraisal index of Residential Environment

Item	Sub-item	Sub-item serial number	Item requirement description	Score	Sort
Land use and plan	Land use	B03	Keep away from pollution, avoid and effectively control the impact on resident of water, air, noise, radiation pollution.	4	V

	Space layout	B05	The layout of building should satisfy the requirement of natural lighting and ventilation, avoid interference of sight line.	6	IV
		B06	Space arrangement of the buildings should be clear, which should guarantee the quiet life of residents.	4	I
Green land, and playground	Green land	B21	☆Green space ratio shouldn't be less than 30	6	II
		B22	Public green areas per capita	4	II
	Plant, landscaping	B27	Select local plant that is full of vitality, and don't cultivate plants that are poisonous and create air pollution.	2	V
Outdoor air, noise pollution.	Outdoor noise	B33	Noise in the daytime shouldn't be more than 50dB, and noise in the evening shouldn't be more than 40dB	4	I
		B34	Occasional noise in the evening shouldn't be more than 55dB	4	I
	Air pollution	B35	No discharging pollution source or local pollution source with dust remove and desulphurization measures.	3	V
		B36	Using clean fuel, no open local pollution source	3	V
		B37	No local radiant pollution source.	2	V
		B38	No overflowing local pollution source. The restaurant in the community should set up production pollution control measures.	2	V
B39	Air pollution control index shouldn't exceed the standard.	2	V		
Water, drainage system	drainage system	B42	Set consummate separate sewer system of sewage and rain.	4	VI
Public infrastructure	Service & Facilities	B44	Facilities of epidemic prevention, health care, medical care and nursing have been put up.	3	II

	Entertainment & fitness facility	B47	Outdoor playground has been put up in line with green land and environment configuration.	3	II
		B48	Swimming pool has been put up.	3	II
		B49	The padding pool for children has been put up. And water quality meets the requirement of <health criteria of swimming site>(GB9667)	2	II
		B50	Gymnasium has been put up.	3	II
		B51	Multi-functional room for recreation and sports has been put up.	3	II
		B52	Children playground based on the principle of interest, intelligence, safety, fitness has been put up.	3	II
		B53	Sports and assistant service facilities for elders has been put up.	3	II
Public infrastructure	Sanitation	B56	Set ashcan each floor in high-floor and every building in multi-floor. Accumulate the garbage with plastic bag. Keep ashcan clean and carry away the garbage everyday.	7	VII

**Section D—Appraisal index of Residential Safety**

Item	Sub-item	Sub-item serial number	Item requirement description	Score	Sort
Indoor pollution control	Wall material	D40	The radiant pollution of wall material shouldn't exceed the standard of national relevant criterion.	3	V
		D41	Ammonia concentration of concrete Admixtures shouldn't exceed the standard of national relevant criterion.	1	III



	Indoor fitment	D42	Deleterious substance content of artificial boards and their finished products, solvent carpentry dope, inner wall dope, glue, wallpaper, granite, other natural and artificial stone shouldn't exceed the standard of national relevant criterion.	6	III
	Indoor air pollution content	D43	Indoor concentration of radon, dissociative formaldehyde, ammonia, benzene, TVOC shouldn't exceed the standard of national relevant criterion.	15	III

**Section E—Appraisal index of Residential Durability**

<b>Item</b>	<b>Sub-item</b>	<b>Sub-item serial number</b>	<b>Item requirement description</b>	<b>Score</b>	
Tube and wire	Tube and wire design	E22	The inner wall of water supply pipe should be made of copper or other non-pollution, durable materials.	1	VI

Table2: Items relevant to the health performance of residential buildings within the DPRS

## **2.1 Noise quality (37)**

Noise quality outweighs the other factors in the DPRS's concern for the health performance of residential buildings. Noise is believed to be the reason for a lot of mental and physical diseases, such as insomnia and hearing loss (Johnson et al., 1991). In the DPRS, indoor noise reduction is achieved by the strict control of the design specification of inner-walls, floors, and drainpipes, while outdoor noise control is achieved by the design of external walls and windows. Equipment, which is another source of noise, is controlled using vibration reduction and sound insulation.

## **2.2 Facility for build-up (33)**

In today's society, housing not only plays the basic role of habitation, but also provides other needs to residents. Since sport is a necessity of physical and mental health, MOC places much emphasis on entertainment and fitness facilities. These facilities, both indoor and outdoor, should offer opportunities for residents of various ages to build up their bodies. Besides, MOC stresses the provision of playgrounds for children, as well as service facilities for the elderly. Residents may also encounter emergencies, such as disease outbreaks and accidents, and therefore entertainment and fitness facilities, facilities of epidemic prevention, health and medical care, and nursing should also be set up.

## **2.3 Indoor air quality (30)**

The outbreak of SARS brought forth sharp suspicions of indoor air quality (IAQ) among Chinese residents, which led to more air quality inspections. The major reason for poor IAQ was that fresh air supply indoor was inadequate. The DPRS stresses provision of natural ventilation for bedrooms and kitchens and a sufficient amount air exchange between indoor and outdoor (30m<sup>3</sup> per hour).

Along with economic development, the living conditions and incomes of Mainland dwellers are improving. Most residents are inclined to have their property well decorated. But many furniture materials don't meet national compulsory standards. The occurrence of poisoning as a result of poor furniture materials has been very common (北京青年報,2003). Subsequently, the DPRS has set down regulations concerning this problem. The concentration of deleterious gas is now required to meet national compulsory standards.

## **2.4 Natural lighting and views (21)**

According to the DPRS, sufficient access to sunlight in public spaces, living rooms, master bedrooms, and kitchens must be provided. It is believed that natural lighting can redound to residents' health and enhance energy efficiency. Artificial lighting alone will not be able to satisfy the residents. MOC also assumes that a pleasant view of the external environment through the windows is indispensable to achieving a good health performance. Interference with the sight line will affect residents' mental health. Hence, MOC calls for

an appropriate layout of an estate in a neighborhood to ensure that each unit has a nice view.

## **2.5 Outdoor pollution control (21)**

Nowadays, residents need to face pollutions from outdoor air, water, noise, and radiation. It goes without saying that pollution harms our health. But nobody can evade the impact of pollution. The only thing the government can do is set strict controls over pollution. In the DPRS, MOC directs that residences should be located away from pollution sources, and dictates that the property management companies should dispose of pollutants produced in community properly.

## **2.6 Drainage system and waterscape (11)**

SARS also spread through the drainage systems, which gave rise to prevalent worries about health performance of residential buildings. In order to avoid a diffusion of infectious diseases between units, the residential and commercial portions within the same development should not share the same drainpipe.

Clean water for drinking is a minimal guarantee of residents' physical health. Water pipes should be made of sustainable materials such as stainless steel. Outdoor water bodies also pose hidden troubles for residents' health. Many developers develop waterscape in the community, but have no interest to maintain it. In some communities, the outdoor waterscape is smelly, which is prohibited under the DPRS.

## **2.7 Garbage collection (10)**

Garbage, which is the source of bacteria and pests, is a potential menace to residents' health. According to the DPRS, developers should set up sufficient garbage collection facilities in the community. It is necessary to set up at least one garbage room or garbage bin on each floor in high-rise buildings, and one garbage bin in each building block in medium-rise residences. To prevent the breeding of pathogens, garbage should be cleared away every day.

## **3. Comparative study of foreign systems with the DPRS**

Many countries have similar building performance appraisal systems. The LEED (Leadership in Energy and Environment Design, U.S.) and the GBC (Green Building Challenge assessment method, Canada) developed in the US and Canada, respectively, are schemes that have already been implemented widely. The Building Health and Hygiene Index (BHHI) developed relatively recently in Hong Kong focuses on the health and

hygiene aspects in the high-rise residential buildings (Chaw, K.W. et al. 2004). Table 3 gives a detailed comparison of these schemes with the DPRS.

		DPRS (Chia)	LEED (U.S.)	GBC (Canada)	BHHI (HK)
<b>Nature of Assessment</b>	Voluntary		√	√	√
	Mandatory	√			
<b>Targeted Building Groups</b>	Residential buildings	√	√	√	√
	Non-residential buildings		√	√	
	New buildings	√	√	√	√
	Existing buildings		√	√	√
<b>Scope of Assessment</b>	Density	√		√	√
	Air pollution	√	√	√	√
	Light pollution		√	√	
	Noise	√	√	√	√
	Heat island		√	√	
	Water	√			√
	Waste Disposal	√	√	√	√
	Cleanliness	√		√	√
	Natural Lighting & View	√	√	√	√
	Natural ventilation	√	√	√	√
	Indoor air quality		√	√	√
	Acoustics	√		√	
	Thermal Comfort		√	√	√
	Humidity			√	√
	Green Land & Planting	√	√	√	
	Build-up facilities	√			
	Maintenance of building envelope performance			√	
Maintenance of operation			√	√	
<b>Stages of Building Life-cycle Influenced</b>	Planning	√		√	
	Design	√	√	√	√
	Construction	√	√	√	
	Operation	√		√	√
	Demolition			√	

Key: √ = Applicable; √ = Marginally applicable

Table 3: Comparison of different schemes with respect to health performance

The LEED, GBC and BHHI schemes are all voluntary in nature while the DPRS is a mandatory scheme. The LEED and GBC cover all building types (Daniele and Cesano, 2002; U.S. Green Building Council, 2004), be they new or old, while BHHI is applicable to all residential buildings. Comparably speaking, the DPRS is only targeted to a limited group of newly built residential buildings.

Among the four schemes, the coverage of the GBC is the widest in terms of scope of assessment. It covers sixteen out of eighteen aspects of the Building Health Elements like density, air pollution etc. (Table 3). The other three schemes cover more than half of the Building Health Elements which shows that the four schemes under comparison all take into consideration lots of elements concerning the health performance of buildings. Yet from Table 3 we can find some special features within different schemes. For example, the GBC is the only scheme that pays attention to the “maintenance of building envelope performance” while the DPRS is the only scheme that takes “Build-up facilities” into consideration.

As far as the stages of the building life-cycle influenced, the GBC turns out to be the all-rounded scheme again (Joel Ann Todd et al. 2001). It covers the whole life cycle of the buildings from the planning stage, through the design, construction, operation and deconstruction process. The LEED scheme put most of its emphasis on design and construction while BHHI focuses on the design and operation process. The DPRS is mainly designed to direct the planning and design process but it also considers some construction and operation issues during the building life cycle.

Apart from the above differences, the four schemes also have their own features. For example, LEED offer technical support to registered projects (Drury Crawley and Ilari Aho 1999), GBC requires a third party to adjust its specifications to suit the unique conditions applicable to certain building types in various regions (International Initiative for a Sustainable Built Environment, 2004). The most outstanding feature of the BHHI is that it pays great attention to the building management elements. The weightings of factors under the ‘management’ category add up to nearly half of the total weighting (Ho et al. 2004). Meanwhile, the index system of the BHHI is easily understood and the inspection work can be done quickly at a much lower implementation cost (Chau, K.W., 2004).

#### **4. Conclusion: Future advancement of the DPRS’ health concern**

After the international comparative study of the DPRS with LEED, GBC and BHHI, we can point out some future advancement of the DPRS.

First, the DPRS should utilize its governmental backup for future development. Unlike LEED, GBC and BHHI, the dwelling performance rating system in Mainland China is executed by the Center for Housing Industrialization under the MOC. A lot of resources have been incorporated into the DPRS due to its governmental background. For example, in 2002 the MOC and Industrial and Commercial Bank of China (ICBC) signed a contract

to mutually push forward the DPRS (建設部住宅産業化促進中心,2002). According to the contract, projects with “A” ranks or above will get priority to development loans and the buyers of these projects will be granted mortgage loans first. This kind of cooperation with large national organizations is a major advantage of the DPRS which shall be fully realized in the future.

Second, the targeted building groups should be expanded to existing residential buildings. Rating systems of LEED and GBC have covered almost all building types while the BHHI is applicable to all residential buildings. Up to now, the DPRS only focuses on newly built residential buildings which limit its influence to the general public. Two problems need to be resolved before the DPRS can expand. On one hand, the pool of competent appraisers is very limited. On the other hand, the cost for a single building appraisal is hardly affordable for most owners of existing residential buildings.

Third, the index system of the DPRS should be simple and sustainable. Now there are 266 items in the index system of the DPRS which make it too complex for the public to understand. Besides, some items in the DPRS are related to today’s building technologies which need to be amended frequently later. As DPRS is going to be the future national standard of housing performance appraisal, it should be simple in conveying more information to the public as well as remaining stable with the development of construction technologies. Besides, simple and stable index system will greatly reduce the implementation cost of the DPRS.

Fourth, more management factors shall be added. The BHHI’s concern over the management part of the building performance is a good reference to the DPRS. Up to now, the DPRS has put most of its effort on the planning and design part of building performance and the management part is nearly neglected. Since more and more evidence shows that the management side of building health performance is more important (Ho et al. 2004), the DPRS should take more operational issues into consideration.

## References

- Center for housing industrialization, CHI. (2004). *Index System of the Standard of Housing Performance Appraisal* . Report by the Center for housing industrialization to the Ministry of Construction, People’s Republic of China, 50 pages.
- Chaw, K.W., Ho, D. C. W., H. F. Leung, S.K. Wong, A.K.C. Cheung. (2004). **Improving the living environment in Hong Kong through the use of a building classification system- a win-win-win solution for the community, the government, and tertiary institutions in Hong Kong.** *Chartered institute of Buildings*, 4, 14-15.
- Daniele and Cesano (2002). *Market needs for promoting LEED Rating system and green building design*, KCI program.
- Drury Crawley and Ilari Aho (1999).*Building environmental assessment methods: applications and development trends*, Building Research & Information,27(4), pp.300-308.

- Ho, D. C. W., H. F. Leung, S.K. Wong, A.K.C. Cheung, S.S.Y. Lau, W.S. Wong, D.P.Y. Lung and K.W. Chau. (2004). **Assessing the health and hygiene performance of apartment buildings**. *Facilities*, 22(3/4), 58.
- International Initiative for a Sustainable Built Environment (2004). *A overview of GBtool*, March 07, 2004
- Joel Ann Todd et al. (2001). *Comparative assessment of environmental performance tools and the role of the Green Building Challenge*, Building Research & Information, 29(5), pp.324-355.
- Johnson, B.G., Kronvall, J. Lindvall, T., Wallin, A. and Lindencrona, H.W. (1991), *Buildings and Health: Indoor Climate and Effective Energy Use*, Swedish Council for Building Research, Stockholm.
- U.S. Green Building Council (2004). *An Introduction to the U.S. Green Building Council and the LEED Green Building Rating System®*, December 2004
- 建設部住宅產業化中心《住宅性能評定指標體系》2004，北京：建設部住宅產業化中心
- [http://sdep.cei.gov.cn/envir\\_sub/source/2003050902z.htm](http://sdep.cei.gov.cn/envir_sub/source/2003050902z.htm)（藺麗爽，雲石，《室內空氣質量不達標 偽劣建材是禍首》，北京青年報，2003年5月9日）
- <http://www.chinahouse.gov.cn/xnrd3/c-2.htm>（《中華人民共和國建設部與中國工商銀行在推進住宅產業現代化方面進行雙邊合作》，建設部住宅產業化促進中心）